Asymmetrical distalization of maxillary molars with zygomatic anchorage, improved superelastic nickel-titanium alloy wires, and open-coil springs

Takayoshi Ishida, a Hyung Sik Yoon, b and Takashi Ono c
Tokyo, Japan

Introduction: In nongrowing patients with skeletal Class II malocclusion, premolar extraction or maxillary distalization can be used as camouflage treatment. Zygomatic anchorage enables distalization in uncooperative or noncompliant patients. We describe 1 such procedure in a 24-year-old woman. Methods: We used novel improved superelastic nickel-titanium archwires combined with nickel-titanium open-coil springs to provide a constant and continuous low force to the dentition. Results: We were able to successfully eliminate the protrusive profile and correct the Class II molar relationship using this system of zygomatic anchorage. The posterior occlusal relationships were improved to achieve Class I canine and molar relationships on both sides, and ideal overbite and overjet relationships were established. Facial esthetics was improved with decreased protrusion of the upper and lower lips. Conclusions: The method used here is a promising alternative to traditional distalization techniques and might offer an effective and simple means of distalizing maxillary molars in uncooperative patients. (Am J Orthod Dentofacial Orthop 2013;144:583-93)

Nonextraction treatment of Class II malocclusion in adult patients usually requires distal movements of the maxillary molars to establish Class I molar and canine relationships. However, distalization of the maxillary molars is difficult after complete eruption of the second molars in nongrowing patients. Moreover, maxillary unilateral molar distalization is more difficult than correcting a bilateral Class II relationship because the clinician must design an asymmetric force system.

Previous studies have reported unilateral molar distalization with the application of asymmetric face-bows, 1-3 improved Nance appliances, 4 and the Keles slider. 5 However, these appliances have disadvantages, such as their unesthetic appearance, loss of anchorage in the maxillary premolars, proclination of the incisors, relapse during retraction of the premolars and anterior teeth, undesirable intermittent forces, and dependence on patient cooperation. These treatment plans are thus unpopular with orthodontists.

To remedy the problems of noncompliance, intraoral distalizing mechanics combined with a skeletal anchorage system consisting of titanium anchor plates and monocortical screws has attracted attention. The implant anchor plate has been used as a multipurpose modality combined with a multibracketed appliance and enables movement of the maxillary molars distally without replacing the anchorage device during molar distalization. Furthermore, orthodontists can modulate the direction of force because the head portion is intraorally exposed and has 3 adjacent hooks for force adjustment.

Superelastic nickel-titanium wires have been widely used in clinical orthodontic treatment. 6,7 These wires have many special properties including a shape-memory effect and superelasticity. Our department at Tokyo Medical and Dental University in Japan has developed an improved superelastic nickel-titanium wire and nickel-titanium open-coil spring that can generate orthodontic forces that vary minimally in response to changes in oral temperature. 8

In this case report, we describe the treatment of a woman with a skeletal Class II pattern and a unilateral
Fig 1. Pretreatment facial and intraoral photographs.

Fig 2. Pretreatment dental casts.
Class II molar relationship using a system of zygomatic anchorage, and nickel-titanium alloy wires and open-coil springs.

**DIAGNOSIS AND ETIOLOGY**

The patient was a 24-year-old woman with dental crowding and some difficulty in achieving lip closure. Pretreatment facial photographs show a convex profile.
and protrusion of the upper and lower lips, both of which exceeded the E-line (upper lip, 3.0 mm; lower lip, 4.5 mm) and were strained upon closure (Fig 1). During lip closure, a mentolabial fold was observed in the chin area. A 1-mm deviation of the chin to the left of the midline was also evident. The right molar relationship was Class I, whereas the left molar relationship was Class II (Fig 2). The maxillary midline deviated 1.5 mm toward the right, and the mandibular midline was 1.0 mm left of the facial midline.

The patient had a 1-mm overbite and a 4-mm overjet. A pair of lateral and anteroposterior cephalometric radiographs and a dental panoramic radiograph were taken before treatment (Fig 3). The cephalometric tracing (Fig 4) and analysis (Table) demonstrated a Class II skeletal relationship (ANB, 4.5°) because of the retracted mandible. The SNA angle was within the normal range (79.6°), and the SNB angle was small (75.1°). The angle between the maxillary incisors and the SN plane was 105°, the mandibular incisor to mandibular plane angle was 106.9°, and the interincisal angle was 112.6°. The patient had a large tongue and a tongue thrust. Based on these findings, the patient was diagnosed as skeletal Class II with asymmetric molar relationships.

**TREATMENT OBJECTIVES**

The treatment objectives for this patient were to (1) relieve the crowding, which was her chief complaint; (2) eliminate the tongue thrust; (3) establish Class I molar and canine relationships; (4) correct the midline shift; (5) create ideal overbite and overjet; and (6) ultimately improve her facial profile.

**TREATMENT ALTERNATIVES**

The patient had mandibular retraction with lateral deviation. In growing children, orthopedic forces exerted by functional appliances can result in positive growth modification, which encourages growth of the mandible to correct the defect. In our adult patient, orthognathic surgical treatment was initially discussed as a means of correcting the skeletal discrepancy and the facial asymmetry, but this solution was rejected. For adults not wishing to undergo surgery, camouflage treatment with selective tooth extractions is a popular alternative. A nonsurgical approach with extraction of the maxillary first premolars and mandibular second premolars combined with the use of a transpalatal arch, J-hook headgear, or cervical headgear as

![Fig 5. A, Uprighting the maxillary and mandibular molars and leveling the mandibular teeth; B, anterior and premolar retraction; C, maxillary distal apical movement.](image-url)
Fig 6. Posttreatment facial and intraoral photographs.

Fig 7. Posttreatment dental casts.
anchorage for retraction of the anterior teeth is the traditional method. However, such methods carry a risk of reducing the space available for the tongue. This patient did not want any teeth extracted except for the third molars. Therefore, we extracted the third molars and chose the zygomatic anchorage as the approach for distalization.

**TREATMENT PROGRESS**

Before the orthodontic treatment, Y-shaped anchor plates (Orthoanchor SMAP; Dentsply-Sankin, Tokyo, Japan) were implanted onto the zygomatic process of the maxilla through the buccal mucosa under local anesthesia, and the maxillary and mandibular third molars were extracted. The plates were contoured to fit the bone surface. The head of the plate was intraorally exposed and positioned outside the dentition. After a month of healing, integration, and adaptation, 0.018 × 0.025-in slot preadjusted edgewise appliances (Sankin, Tokyo, Japan) were bonded to each tooth, and a 0.016 × 0.022-in improved superelastic nickel-titanium alloy wire (L&T H Tomy, Tokyo, Japan) was used for the initial leveling.

During leveling of the posterior teeth, a nickel-titanium open-coil (100 g) spring was placed between the first molars and the second premolars to move the first and second molars distally, and a multibracket appliance was placed on the maxillary dentition (Fig 5, A). During distal movement, a tie-back ligature wire was connected from the hook of the anchor plate to the power hook to eliminate the reciprocal force. At the same time, the mandibular right molars were uprighted with Class III elastics. Class III elastics were applied from the mandibular right first premolar to the anchor plate for 3 months (Fig 5, A). After distal movement of the maxillary first and second molars, distal movement of the anterior segment was performed using sliding mechanics (Fig 5, B). After space closure, distal apical movement was induced using an archwire with tip-forward bends (Fig 5, C).

While the orthodontic treatment was in progress, the patient learned new tongue positions at rest and during

**Fig 8.** Posttreatment lateral and posteroanterior cephalometric and panoramic radiographs.
Fig 9. Superimposed tracings of the pretreatment (black line) and posttreatment (red line) cephalometric radiographs.

Fig 10. Two-year retention facial and intraoral photographs.
Fig 11. Two-year retention dental casts.

Fig 12. Two-year retention lateral and posteroanterior cephalometric and panoramic radiographs.
swallowing. Her compliance was excellent throughout the treatment. After 2 years of edgewise appliance treatment, a circumferential-type retainer with a tongue crib was placed in the maxilla, and a Hawley-type retainer was placed in the mandible.

**TREATMENT RESULTS**

Crowding, which was the patient’s chief complaint, was eliminated. The midline deviation was corrected, and the dental midlines were aligned with the facial midline (Fig 6). The posterior occlusal relationships were improved to achieve Class I canine and molar relationships on both sides, and ideal overbite and overjet relationships were established (Fig 7). The posttreatment cephalometric and panoramic radiographs are shown in Figure 8. The posttreatment cephalometric analysis is given in the Table.

Superimposition of these radiographs before and after treatment (Fig 9) showed that the maxillary incisors were intruded by 1.0 mm, their incisal edges were displaced by 6.0 mm, and the apices moved 2.0 mm distally from their initial positions. In the mandible, the central incisor edge was moved 2.5 mm lingually. Moreover, the right maxillary molars were distalized by 4.5 mm on the right and 3.5 mm on the left; the mandibular molar on the right side was uprighted (protracted) 2.0 mm, and the left molar was uprighted 1.0 mm from its initial position. Facial esthetics was improved with decreased protrusion of the upper and lower lips. The

![SN plane at FH](image1)
![ANS-PNS at PNS](image2)
![Mandibular plane at Me](image3)

**Fig 13.** Superimposed tracings of posttreatment (red line) and 2 years postretention (green line) cephalometric radiographs.

![A](image4)
![B](image5)
![C](image6)

**Fig 14.** A, Uprighting the maxillary molars; B, anterior and premolar retractions; C, distal apical movement.
maxillary intercanine width increased by 1.5 mm, and the mandibular intercanine width increased by 0.5 mm. Posttreatment stability of the occlusion was observed after 2 years (Figs 10-13). Two years after the end of the treatment, the occlusion was acceptable.

**DISCUSSION**

In camouflage treatment of a patient with a skeletal Class II pattern and a Class II molar relationship, extractions of maxillary teeth or in both arches are commonly used to correct crowding, protrusion, and occlusal relationships. It is problematic to correct a Class II molar relationship to Class I by distalizing the maxillary molars, although intraoral and extraoral appliances can be used for this purpose. However, successful treatment using extraoral appliances depends heavily on patient cooperation. Intraoral appliances have negative effects, such as anchorage loss in the maxillary premolar region and proclination of the incisors because of the reciprocal force of the molar distalization. Consequently, care must be taken to prevent anchorage loss of the distalized molars during retraction of the anterior teeth. Orthodontic implants have emerged as an effective solution to many of these problems.

Superelastic nickel-titanium alloy wires have properties of shape memory and superelasticity. However, conventional superelastic nickel-titanium wires show large stress hysteresis and thus produce orthodontic forces that are known to be modulated strongly by changes in the oral environment. Consequently, Otsubo developed improved superelastic nickel-titanium wires that can provide a relatively constant continuous force irrespective of the oral environment. Moreover, tooth movement with the improved superelastic nickel-titanium wires follows the 2-phase theory of tooth movement (rather than the 3-phase theory, which is usually seen only when heavy dissipating forces are applied). This is similar to physiologic tooth movement where it is observed that directional bone resorption occurs on the compression side without showing widespread hyalinization and undermining bone resorption. Therefore, we used improved superelastic nickel-titanium wires and nickel-titanium alloy open-coil springs in this patient.

We arranged a force system for 2-phase molar distalization of the maxillary segment, based on the system our department has reported previously. During the first phase, we induced maxillary molar uprighting by distal tipping of the crown using the improved superelastic nickel-titanium wires with tip-back bends and nickel-titanium open-coil springs (Fig 14, A). After distal tipping of the crown, we retracted the premolars and the anterior teeth (Fig 14, B). After space closure, distal apical movement was induced using an archwire with

---

**Fig 15.** A, Applying Class III elastics to zygomatic anchorage; B, uprighting the mandibular molars and leveling the mandibular teeth without reciprocal forces.
tip-forward bends (Fig 14, C). We also applied Class III elastics to the zygomatic anchorage (Fig 15, A) to upright the mandibular molars and level the mandibular teeth (Fig 15, B). In so doing, we could completely cancel out the reciprocal force of the molar distalization without resorting to extraoral appliances.

Facial attractiveness is related to several factors: ethnic group, age, sex, region, and professional background.18-28 Ethnic and racial differences in particular play major roles in judging facial esthetics.19,21,24,26,28,29 Thus, it is important to know the facial preferences of each ethnic group before orthodontic treatment.30 Alcalde et al31 analyzed the soft tissues of a representative sample of normal Japanese subjects within a highly selective group of “esthetically pleasant” profiles to quantify the cephalometric values for their soft-tissue profiles. In our patient, the final facial esthetics approached Japanese supernormal values (Ricketts’ E-line: upper lip, 4–1 mm; lower lip, 1–1.5 mm; Holdaway’s H-line, 2.5–0 mm).

CONCLUSIONS

This case report demonstrates the effectiveness of a nonextraction approach for treating a unilateral Class II molar relationship using zygomatic anchorage, improved superelastic nickel-titanium wires, and nickel-titanium open-coil springs. When patient cooperation is lacking, this mechanical system offers an excellent alternative to traditional treatment modalities for this type of defect.

REFERENCES